Conditions of urban green areas influences bee guilds responses

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Abstract

The UN estimates that the urban population will exceed 60% by the year 2050. Environmental changes resulting from this growth will affect mainly medium-sized cities (between 500 thousand and one million inhabitants). The urbanization process causes drastic changes in the landscape, often irreversible, such as the increase of areas impervious, water pollution and the destruction of natural areas. The deforestation consequent of urban sprawl is one of the causes of decline of wild bee communities and urban green areas (UGA), can be bee-friendly with potential to act like refuge for bees, with foraging and nesting conditions. This study analyzed the influence of UGA conditions and their surroundings in bee guilds responses in a medium-sized Brazilian city (Campos dos Goytacazes, RJ). The bees were sampled for 12 months (2017-2018) in 12 UGAs; bee abundance and richness were evaluated in guilds considering: Nesting behavior (eusocial, intermediate and solitary), nest location (cavity and soil) and Trophic specialization (generalist and specialist). We used as explanatory variables conditions of UGAs - number of trees (NT), DBH, flower cover (FC), plant richness (PR), percentage of paving (PV) and of their surroundings - paving (SPV) and number of buildings with more than three floors (NB).

Keywords: conservation; environmental management; pollinators; urban spraw.

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The UN estimates that the urban population will exceed 60% by the year 2050

Cities with 500.000 to one million inhabitants will be more affected (where 50% of the world's urban population currently lives)

Campos dos Goytacazes, RJ, Brazil http://www.w3.com.br

(United Nations 2019)

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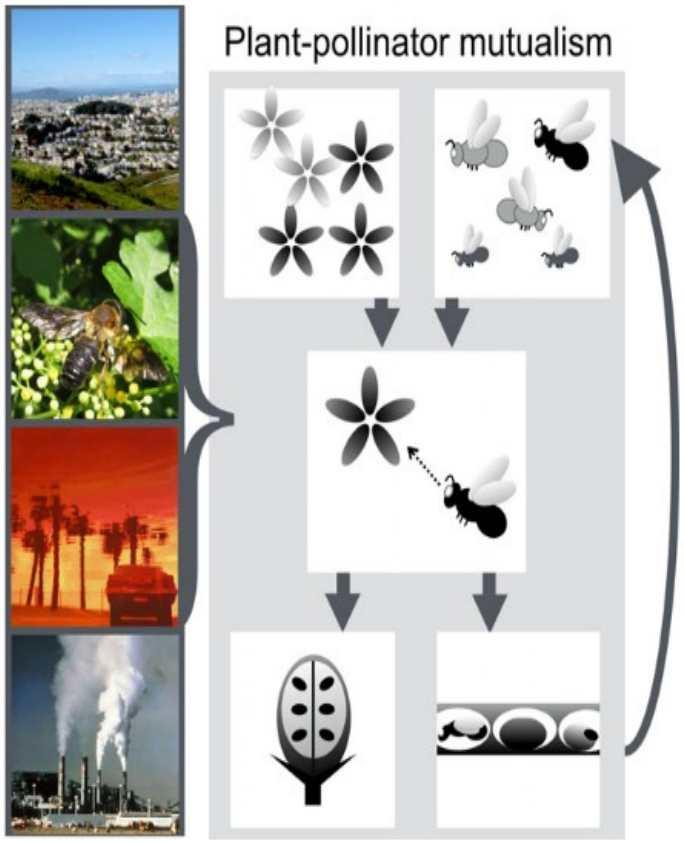
Drastic changes in landscape caused by urbanization process

- Increase of impervious areas
- Destruction of natural areas
- Pollution



(Harrison *et al*. 2015)

with consequences to bee's conservation

- Loss of nesting and foraging sites
- Interruption of ecological interactions
- Biodiversity loss

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Urban green areas (squares, parks and gardens) can be bee-friendly spaces with foraging and nesting conditions

The management needs to consider the different biological and functional bee traits

nesting habit, degree of sociality, trophic specialization

www.mysabah.com

Background

✓**To consider bee guilds in management and conservation planning can increase the efficiency of actions**

✓**Knowledge about the structure of bee communities and how the conditions of urban green areas and their surroundings influence it can contribute to the management and strategies for preserving biodiversity**

✓ **Little is known about how the different bee guilds respond to conditions found in urban areas**

We aim to know...

1) What is the community structure found in urban green areas associated to a medium-sized city in Brazil?
2) What are the environmental conditions of urban green areas and their surroundings?
3) How do the different bee guilds respond to the conditions of urban green areas?

Materials and Methods

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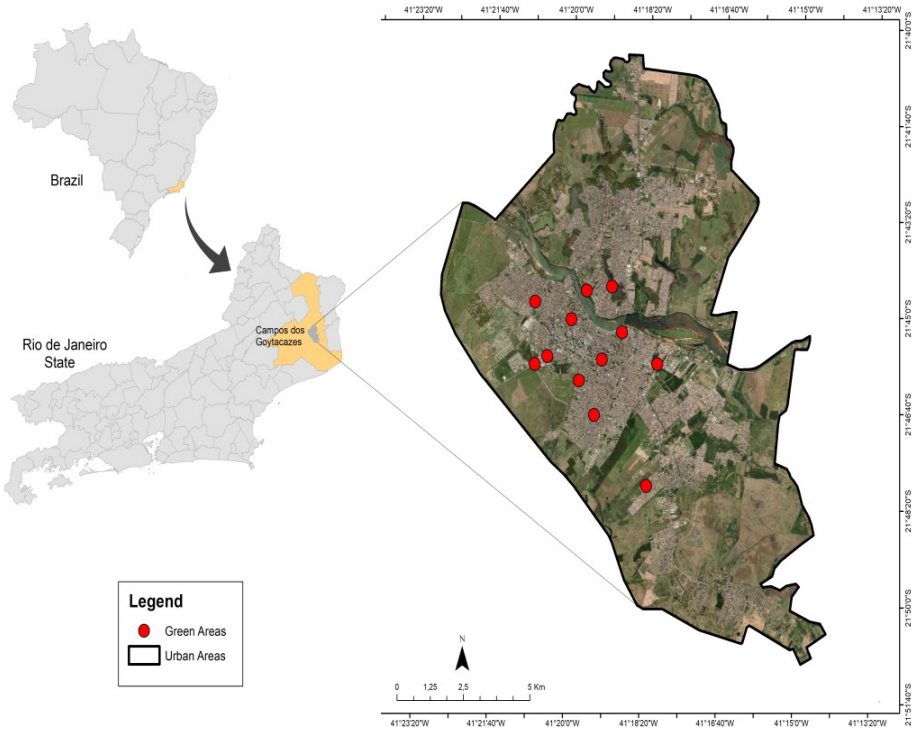
✓ **Study area: Campos dos Goytacazes, RJ, Brazil.**

✓ **12 urban green areas (UGA)**

✓**Bees sampled visiting flower with entomological net**

✓ **One year sample (october 2017 to september 2018)**



✓ **Explanatory variables:**

- Paved area
- Richness of plants visited by bees
- Flower coverage
- Nmber of trees
- DBH
- Impervious area inside and around UGA,
- Number of buildings

✓ **Bee Guilds classified by:**

1) Nest location (soil or pre-existing cavity);
2) Nesting behavior (solitary, intermediate, eussocial);
3) Diet specialization (generalist, specialist)

Results and Discussion

Table 1: Environmental conditions of 12 urban green areas (UGA) studied in Campos dos Goytacazes/RJ. Inside UGA: percentage of paving (PV), number of trees (NT), diameter in breast height (DBH), plant richness (PR), flower coverage in m² (FC). Surround conditions measured inside a buffer of 500m from UGA center: surround percentage of paving (SPV) and number of buildings with more than three paviments (NB).

	URBAN GREEN AREAS											
Conditions	**U1**	**U2**	**U3**	**U4**	**U5**	**U6**	**U7**	**U8**	**U9**	**U10**	**U11**	**U12**
PV	61.3	92.5	50.4	37.3	35.9	27.8	0	63.0	90.3	19.4	8.7	70.9
NT	34	36	33	22	46	78	22	33	15	63	369	17
DBH	23	27	16	22	26	35	63	30	53	22	32	32
PR	13	11	12	6	13	14	17	9	10	14	18	14
FC	60.8	47.5	10.6	6.5	42.6	33.7	82.5	22	22.7	26.7	21.3	11.7
SPV	63	96	87	71	92	97	45	51	72	84	75	89
NB	12	0	11	14	60	37	4	0	8	0	7	10

Results and Discussion

Table 2: Parameter estimates of a generalized linear model, assessed as most parsimonious according to AIC, explaining abundance and richnees of bee guilds in urban green area (UGA) in Campos dos Goytacazes/RJ. Inside UGA: percentage of paving (PV), number of trees (NT), diameter in breast height (DBH), plant richness (PR), flower cover in m² (FC). Surround conditions measured inside a buffer of 500m from UGA center : surround percentage of paving (SPV) and number of buildings with more than three paviments (NB).

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Variables	Model	NT	FC	DBH	PR	PV	SPV	NB	Intercept	df	AIC	ΔAIC	Weight	AdjR²
Abundance														
Eusocial	5		1.079						40.42	3	126.5	0	0.191	0.341
Intermediate	5		0.109						2.188	3	66.8	0	0.396	0.438
Solitary	17					0.143			9.282	3	96	1.51	0.164	0.110
Soil	33						0.374		43.88	3	92.2	0	0.438	0.386
Cavity	5		1.162						44.16	3	127.3	0	0.263	0.359
Specialist	13		0.106	-0.157					3.221	4	68.7	1.04	0.149	0.461
Generalist	5		1.235						55.28	3	126.7	0	0.279	0.399
Richness														
Eusocial	33			0.05			0.039	0.034	-1.938	5	34.5	0	0.334	0.876
Intermediate	5		0.089						1.618	3	51.1	0	0.276	0.333
Solitary	73			-0.108				0.076	9.827	4	61.4	0.1	0.152	0.50
Soil	5		0.045						1.618	3	51.1	0	0.276	0.333
Cavity	3	0.0137							4.537	3	59.4	0	0.121	0.300
Specialist	5		0.013						0.125	3	37.7	2.2	0.083	0.461
Generalist	9			-0.065					12.65	3	66.2	2.48	0.082	0.094

Results and Discussion

- Different guilds of bees diverged in responses to conditions found in urban green areas and their surroundings.

- Bees community structure showed a composition mainly of eusocial and generalist bees, common in open and highly modified environments. They live in colonies with thousands of individuals active throughout the year and collect a large amount of resources quickly and during all year.

- The greater plasticity of *A. mellifera* favors the increase of its abundance in urban areas and the competitive pressure on native species, which can lead to the homogenization of the structure of the bee community in these areas.

- Specialists represented only 20% of the community. The decline of specialist bees is directly related to the loss of the host plant and also by competition with generalist bee species over resources.

- As paving of the surroundings increases, abundance of nesting soil bees decreases. The availability of nest building sites may be more important in the establishment and growth of their populations than the availability of food resources.

- Costs of foraging trips is critical for abundance and richness of solitary bee guilds. Considering that few individuals in this group reach long flight ranges, solitary bees depend on the resources available near the nests.

Conclusions

We suggest that decisions about management of urban green areas must be a transdisciplinary decision making and planning. The management of urban green areas is complex and it is necessary to pay attention to factors that contributes to minimize the negative effects of urbanization on the bee community to find nesting places, foraging and feeding needs. Bee conservation programs in urban areas should include the management of plants that provide resources for bees and other pollinators and avoid the increase of impervious surfaces. This vision is pursued within two of the UN Sustainable Development Goals (SDGs) item 15, which deals with terrestrial Life and aims to protect, recover and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, stop and reverse the degradation of the Earth and stop the loss of biodiversity. Also item 11 that deals with Cities and sustainable communities with the objective of making cities and human settlements inclusive, safe, resilient and sustainable. This work considers that the planned urban policies, considering other organisms besides humam beings, can lessen the negative impacts of rapid urbanization. A new way of looking at the city, one that considers man as part of the ecosystem and that by conserving other species will be conserving its quality of life in the urban environment.

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